Observations on the Yosemite bark weevil in California[1]

(Coleoptera : Curculionidae)

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The Yosemite bark weevil, *Pissodes yosemite* Hopkins, is widely distributed in the pine forests of the Pacific Coast states (Fig. 1). It has been collected from *Pinus ponderosa* Laws., *P. jeffreyi* Grev. and Balf., *P. lambertiana* Dougl., and *P. monticola* Dougl. *P. ponderosa* appears to be its most common host. Although it has been recognized since the early days of forest entomology in the West, *Pissodes yosemite* is not a common or particularly destructive species. Little has been known of its life history and ecological relationships. Most often the weevil is found infesting trees from 2–15 cm in diameter at the groundline; however, it sometimes attacks dying mature trees. The observations reported here deal only with its activities in small trees.

The opportunity to observe *P. yosemite* developed in the course of studies on dying ponderosa pines in plantations near Groveland, Tuolumme County, California, in 1962, 1963, and 1964. These plantations, known collectively as the Spinning Wheel plantations, had progressively deteriorated since their establishment in the mid-1950's. The decline was generally attributed to the pine reproduction weevil, *Cylindrocopturus eatoni* Buchanan. But closer observations revealed that *C. eatoni* could not always be implicated as the sole instrument of mortality. Furthermore, several other insect species, among them *P. yosemite,* were found infesting some of the dying trees.

During this same period, *P. yosemite* was discovered in association with *C. eatoni* in natural regeneration at Anderson Valley near Groveland. More extensive observations further disclosed the two species concurrently infesting the same ponderosa pines near Placerville, El Dorado County, and also near Mt. Shasta, Shasta County. Thus, it appeared that the two species were common associates, and it was inferred that similar host conditions were favorable for both.

Neither species usually infests healthy trees; *P. yosemite* possibly never does. Neither is an infestation of one requisite for success of the other. *C. eatoni* is commonly the only weevil species infesting a tree; *P. yosemite* does this only rarely.

There are several taxonomic problems connected with Nearctic

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Pissodes. In the case of *P. yosemite*, S. G. Smith, Cytology and Genetics Section, Canada Department of Forestry, Sault Ste. Marie, Ontario, informs me (personal communication, March 1966) that cytogenetic evaluation indicates that *P. yosemite* is conspecific with *P. schwarzi* Hopkins. Dr. Smith will discuss the taxonomic implications of this in a forthcoming publication.

DESCRIPTION OF STAGES.—The adult is fully described by Hopkins (1911). Briefly, it is a medium-sized, reddish brown weevil, conspicuously ornamented with patches of white. It varies considerably in size; Hopkins measured 51 specimens and recorded a range of lengths from 5.1–7 mm. These measurements and their variability adequately characterize the specimens collected in this study.

The egg is ovoid, measuring about 0.6 by 0.4 mm. It is smooth, shiny, and translucent when first laid, and has a whitish peripheral area and a faintly yellowish center. The chorion is thin and fragile.

The larvae and pupae are typical of the genus, and are superficially indistinguishable from other species. Mature larvae are about 8 mm long; they are generally yellowish white grubs with light brown head capsules. Hopkins (1911) likewise describes these in detail.

LIFE HISTORY AND HABITS.—Adults are found in the foliage of young trees throughout the summer months. At Groveland in 1963, adults were first found on 8 June, and specimens were collected as late as 30 September. They may well be active both earlier in the summer and later in the fall. Immature stages are also commonly found throughout the summer; in fact, all the developmental stages were represented during July and August (Fig. 2).

Several hibernating adults were discovered in January 1964. These weevils had tunneled into the bases of trees infested during the summer of 1963 and had prepared rough overwintering chambers in the phloem–cambium area. Whether adults hibernate elsewhere was not determined. This adult hibernation is similar in character to that recently reported for the Palearctic species *P. notatus* Fabricius (Viedma 1961). Actually, the entire life cycle of *P. yosemite* is remarkably like that of *P. notatus*.

Caging adults on shoots revealed their habit of feeding on the stems; this habit was subsequently observed many times in the field. Essentially circular on the surface, the feeding punctures are about 0.5 mm in diameter. Beneath the bark their configuration varies, but the pits are generally irregular in shape and 2 to 3 mm in diameter. Similar excavations near the base of the tree are used for oviposition.

In areas where *P. yosemite* is abundant, feeding pits may be found

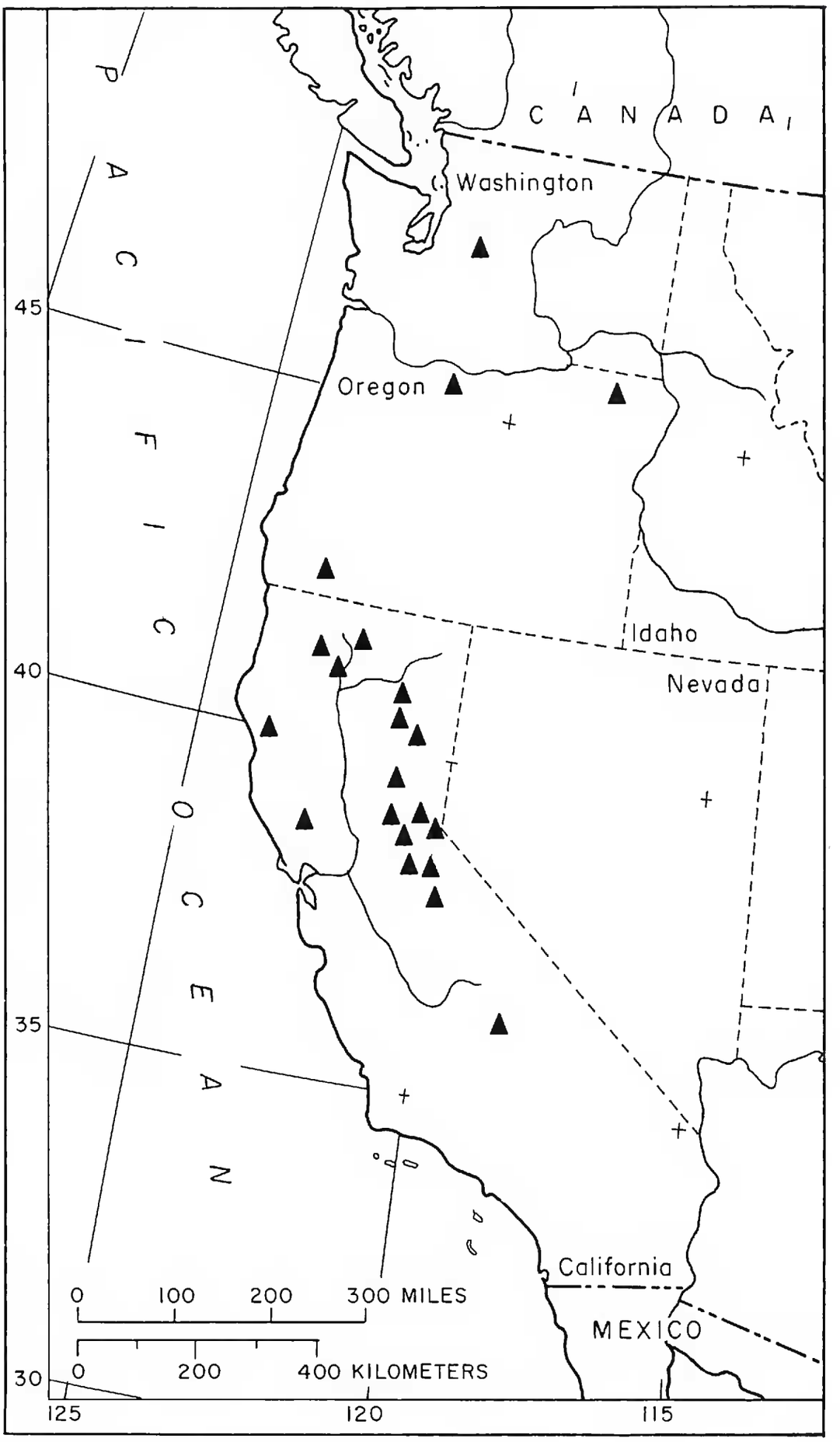

Fig. 1. Distribution of *Pissodes yosemite* Hopkins.

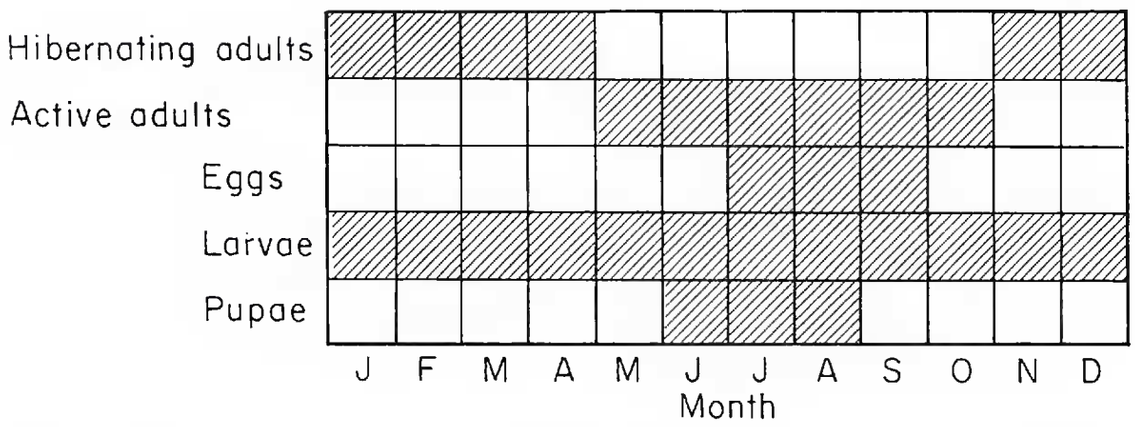

Fig. 2. Occurrence of *Pissodes yosemite* developmental stages at Groveland, Tuolumne County, California, 1963–1964.

commonly on all portions of young trees with the exception of the current year's growth, which is apparently unacceptable. However, the presence of feeding pits does not necessarily indicate that a tree is under attack in the sense that oviposition is taking place.

Although their capabilities for flight are not known, adult weevils did not readily take to the air when disturbed. None was ever observed in flight. This apparent reluctance to fly is coupled with a tendency on the part of the adults to congregate on the same or adjacent trees. In 1962, 25 trees in areas undergoing heavy *C. eatoni* infestation were beaten at intervals of about a week from early June to early August. Of these, 22 failed to yield *Pissodes*. Of the three that did, one yielded a single specimen on a single occasion, while the other two yielded a few (3–10) weevils for 4 and 5 consecutive weeks, respectively. (In each instance the insects were returned to the trees after their presence was recorded.)

Mating occurs on the foliage, and oviposition takes place throughout the summer. In 1963, eggs were first found on 10 July, and the last eggs were found on 10 September. It is possible that some oviposition occurred earlier. On small trees eggs generally are laid in the lower 10 cm of the main stem; less commonly eggs are found slightly below the groundline, and they occasionally are found higher than 10 cm aboveground. One infested stem out of several hundred collected from Anderson Flat contained *Pissodes* brood at a height of about 30 cm above the groundline.

Eggs generally are laid singly in pits similar to feeding pits; in some instances two eggs are deposited. No more than two larval mines were ever found originating from a single oviposition pit.

In August 1963, 10 eggs were removed from oviposition sites for

laboratory observation of incubation time. These eggs were compared with fully developed eggs dissected from a gravid female weevil. Four were judged to have been freshly laid, and these were held indoors on damp filter paper. All hatched in periods of 5 to 9 days. This incubation period is probably of the same order as that required under field conditions. Martin (1964) reports generally similar data for the closely related *P. affinis* Randall and *P. approximatus* Hopkins.

Upon hatching, the larvae begin mining individually toward the roots. For the first 1 cm the mine is just beneath the bark surface, but from then on it lies in the phloem–cambium region. Some larvae move only a short distance into the root–collar area, while others continue along the roots themselves for 10–15 cm. Finally the larvae reverse the direction of the mines and move upward toward and in some cases above the groundline, where they prepare the pupal chambers, or "chip cocoons," which are typical of the genus (Hopkins, 1911).

Except for the relatively uncommon hibernating adults, the weevils all overwinter in the larval stage. Most larvae have completed development by the onset of winter and have constructed chip cocoons. However, larvae of all sizes may be encountered; this situation presumably results from the protracted oviposition period.

Larval feeding is restricted to the cambium and phloem areas; the wood is not scored. The mines are somewhat sinuous, but remain oriented with the longitudinal axis of the tree and do not cross. Frass is packed behind the larvae; that produced by younger individuals is a dull orange color; but, as the larvae grow, more bark is ingested and the frass assumes a deep reddish brown hue.

When the larvae finish feeding, they excavate the chip cocoons. Individual cocoons may be almost totally in the wood or may lie mostly in the bark area. Chip cocoons are generally constructed parallel to the longitudinal axis of trees. Larvae orient themselves head-up in chip cocoons and proceed therein to transform into the pupal and adult stages.

When ready to emerge, adults chew their way out through the chip cocoon and the bark. They leave cleanly cut circular emergence holes 2 to 3 mm in diameter in the bark. All adults in the Groveland population were active during the midsummer period in 1963 (Fig. 2); none was found in chip cocoons after 25 July.

ASSOCIATES.—*C. eatoni* is the most consistent insect associate of *P. yosemite*, which was present in all the active *C. eatoni* infestations examined in 1962 and 1963, both in central and northern California.

Sixty-eight per cent of the *Cylindrocopturus*-infested trees in natural regeneration at Anderson Valley also supported *Pissodes*. At one of the Spinning Wheel plantations 65% of the planted trees infested with *Cylindrocopturus* also supported *Pissodes*. Lower percentages of *Pissodes* were recorded in other areas, but the species was invariably present.

Two species of parasitic braconids[3] were reared from *P. yosemite* at Groveland. The most common of these was a *Doryctes* species, a solitary internal parasite that emerges from fully developed host larvae. *Bracon pini* (Muesebeck) also kills the host near the end of larval development. Both *B. pini* and *Doryctes* sp. are reported from *P. strobi* (MacAloney, 1930), and *B. pini* is reported from *P. terminalis* Hopping (Stevenson, 1963; Stark and Wood, 1964).

Observed parasitism in the Groveland area in 1963, based on 113 reared individuals of *P. yosemite*, was only 9%.

Disease was discovered in a few larvae. It was determined by the University of California Department of Invertebrate Pathology to be *Beauvaria bassiana* (Balsamo) Vuillemin. This apparently constitutes a new host record for this common entomogenous fungus. Impact of the disease on the *P. yosemite* populations observed appeared insignificant.

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[3] Parasites determined by U. S. National Museum specialists.